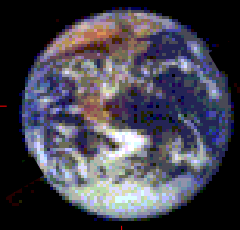
NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

Statewide Transportation / Emergency Operations Center Project No. 14023

FINAL REPORT

July 31, 2003



Edwards AND Kelcey

Transportation

Communications

Building Technologies

SIte and Facilitiy Design

EXECUTIVE SUMMARY

The **New Hampshire Department of Transportation** and the **New Hampshire Department of Safety** are collaborating on the development of a joint Transportation Management Center (TMC) and an Emergency Management Center (EMC) to be located on the campus of the New Hampshire Fire Academy in Concord, New Hampshire. This Incident Management Center (IMC) is envisioned to be a new, fully functional, self-contained building housing the communications and computer infrastructure necessary to coordinate the transportation management system and the incident/emergency management operations throughout the state.

A formal study was conducted by the consulting firm of Edwards and Kelcey to determine the technical requirements of the facility. This was accomplished by establishing the communications/information systems requirements of each participating agency and understanding the operational relationships between the proposed tenants of the facility. The New Hampshire state agencies participating in this study included the New Hampshire Department of Safety, the New Hampshire Department of Transportation, New Hampshire Department of Revenue and Economic Development, and the New Hampshire Department of Administrative Services.

The study was implemented in four phases, based on a systems engineering approach, which included the status of existing communication and information systems, the communication and information systems requirements, the schematic system design, and building system requirements.

Interviews of the potential stakeholders were conducted between February 10th and February 14th, 2003. The objective was to identify the agencies that would staff the facility, develop a comprehensive profile of their existing and planned communication and information systems, and define the operational and information requirements of each agency. The investigation focused on current two-way radio systems, wireline and telephone systems, communication and information technologies and a general assessment of communication networks. The state agencies and agency divisions that participated in the interview process were:

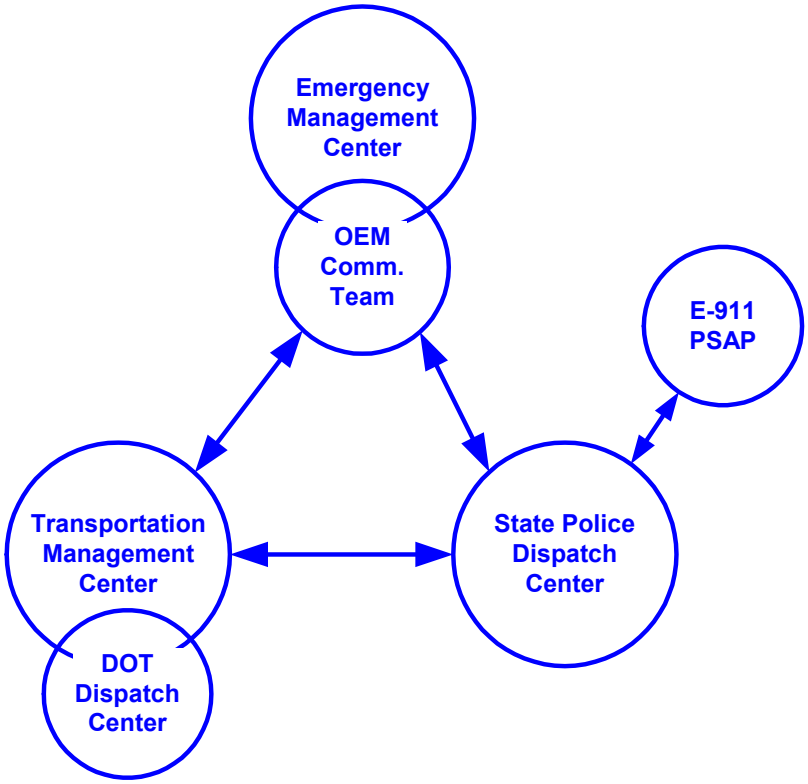
New Hampshire Department of Safety (DOS)
- Division of Fire Safety and Emergency Management
- Division of State Police - Communications
- Marine Patrol
- Information Technology Division

New Hampshire Department of Transportation (DOT)
- Division of Operations
- Bureau of Traffic
- Bureau of Highway Maintenance
- Bureau of Bridge Maintenance
- Bureau of Turnpikes

New Hampshire Department of Revenue and Economic Development (DRED)
- Division of Forest and Lands

New Hampshire Department of Administrative Services (DAS)
- E-911

There will be five (5) primary functional centers within the IMC sharing information on a seamless basis, as illustrated in the figure below:



The **Transportation Management Center** (TMC) and the **DOT Dispatch Center** will be managed and staffed by DOT. The TMC will function as the primary location for the dispatch and management of DOT maintenance forces in response to defined incidents. In this capacity, the DOT will function as a resource agency for support of overall incident response, consistent with the Unified Command structure of the Incident Command System. Within the TMC, the DOT will function as a 24-hour, seven day a week operation, with three dispatch positions and four operational positions (bridges, turnpike, highway maintenance and traffic). The TMC will receive information from Highway Maintenance, Bridge Maintenance, Traffic Operations, Transit Operations, Traveler Information Highway Advisory Radio (HAR), Traveler Information Dynamic Message Sign Systems, Traveler 5-1-1 Center, and Condition and Accident Reporting Systems (CARS).

The **Emergency Management Center** will be managed and directed by the Office of Emergency Management (OEM). The critical component to the EMC is the Communication Team that provides the communication interface between the 30 agencies. The Communications Team, comprised of ten primary positions, will be part of the main operations center, and should operate on a semi-activated basis, or in a ready state for activation, as needed. The EMC will provide 30 workstations and additional supervisory positions for a full activation status. There are 234 local communities that will require a communication linkage to the EOC. Space requirements for the anticipated staffing levels are under development by OEM's architectural consultant.

The New Hampshire State Police will manage the **State Police Dispatch Center**. The dispatch center will function as a 24- hour, seven day a week operation with five dispatch workstations. The State Police will provide service to their staff, as well as Marine Patrol, Department of Fish and Game, and Division of Forest and Lands when these agencies are off duty.

The Department of Administrative Services will manage the **E-911**. The primary operation will be located within the IMC where a minimum of 22 workstation positions are identified are staffing would support a 24-hour, seven day a week operation. E-911 call-takers would serve to provide an efficient agency-to-agency information flow within the IMC.

The communication and information requirements to support the five functional centers are defined as short-term (opening day of the IMC) and long-term requirements (future expansion). The short-term requirements address the needs for radio frequency systems, wire line systems, Information Technology systems and building systems, such as power systems, HVAC, fire detection and security. The long-term requirements address enhanced radio frequency systems, wire line systems, and information and technology systems that are intended to improve the performance of the IMC.

The system configuration forms the basis for the uninhibited flow of information between the primary operating centers in the IMC, as well as information flows into and out of the facility. Within each primary operations center are complex systems for identifying, responding to and resolving incidents. When these agencies work closely together in the IMC, a consistent message set is shared among the agencies from which a unified response to a situation produces a more effective outcome.

The IMC requires several technologically advanced building support systems to meet the operational and functional requirements of the facility. The power system; security system; fire detection and suppression system; heating, ventilation and air conditioning; and computer systems will maintain a consistent and fail-safe environment with minimal maintenance or down-time requirements.

A conceptual cost estimate for the technology components of the building include:

- Communication Technology (communications links)
- Building Systems (required to support the Communication Technology and the Information Systems)
- Information Systems (computers & servers, telephone systems, video wall and dynamic white boards)

The total conceptual cost estimate for technology for the IMC is estimated at $5.4 million. Incorporating the E-911 PSAP could increase this cost by an additional $2.2 million depending on the system upgrade requirements at the time of construction.

This study reviewed the existing communications and information systems of the New Hampshire agencies that would participate in the proposed IMC and established schematic systems requirements for the further development. Short term and long-term requirements that address radio frequency systems, wireline systems, Information Technology systems, and building systems necessary to support the IMC were developed. The system configuration defined the flow of information between the primary operators, as well as the information gathers and users outside the facility. This state-of-the art building, with the necessary workspace and building systems necessary to support the operational and functional requirements of the various state agencies, will be capable of greatly improving New Hampshire's public safety.

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LIST OF COMMON ACRONYNMS

ACD	Automatic Call Director
ANI/ALI	Automatic Number Identification / Automatic Location Identification
AVL	Automatic Vehicle Location
CAD	Computer Aided Dispatch
CAP	Civil Air Patrol
CARS	Condition and Accident Reporting System
CCTV	Closed Circuit Television
CHP	Combined Heat and Power
CISV	Communications Information Services Vehicle
CVISN	Commercial Vehicle Information System and Network
DAS	New Hampshire Department of Administrative Services
DOS	New Hampshire Department of Safety
DOT	New Hampshire Department of Transportation
DRED	New Hampshire Department of Resource and Economic Development
EMC	Emergency Management Center
FDS	Fire Detection and Suppression
FNAMS	Federal National Message System
FNARS	Federal National Radio System
FRN	Frame Relay Network
FRPN	Frame Relay Partitioned Network
HAR	Highway Advisory Radio
HDTV	High Definition Television
HF	High Frequency System
HVAC	Heating, Ventilation and Air Conditioning
IMC	Incident Management Center
ITS	Intelligent Transportation Systems
KSU	Keyed System Unit
LAN	Local Area Network
MARS	Military Affiliate Radio System
MATS	Maintenance Activity Tracking System
MATS	Material Activity Tracking System
OEM	New Hampshire Office of Emergency Management
PMCS	Power Monitoring and Control System
POTS	Plain Old Telephone Service
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network
RWIS	Roadway Weather Information System
SPDC	State Police Dispatch Center
SPOTS	State Police On-Line Telecommunications System Network
SUN	Single Unified Network
TMC	Transportation Management Center
UPS	Uninterrupted Power Supply
VPN	Virtual Private Network
VSAT	Very Small Aperture Terminal
WAN	Wide Area Network

1. INTRODUCTION

The New Hampshire Department of Transportation (DOT) and The New Hampshire Department of Safety (DOS) are proposing the development of a joint Transportation Management Center (TMC) and Emergency Management Center (EMC) to be located on the campus of the New Hampshire Fire Academy in Concord, New Hampshire. This Incident Management Center (IMC) will be a self-contained, fully functional facility and serve as the statewide operations center to support timely and effective incident management and response through the coordination of information exchange, dispatch and emergency operations functions.

A formal study was undertaken to determine the technical requirements for the facility by establishing the communications and information systems requirements and understanding the operational relationships between the proposed tenants of the facility. This study was implemented in four major phases:

1.1 Status of Existing Communications and Information Systems

The objective of this phase was to identify which agencies would staff the IMC and define the operational and information requirements of each agency. A series of interviews were conducted with the responsible authorities of each agency to collect a comprehensive profile of existing operations and planned/future operations. Representatives of each participating agency were required to review and sign-off on the accuracy of the interview results. The Technical Memorandum summarizing the interview results is included in *Appendix A – Technical Memorandum No. 1 – Interview Summary*.

1.2 Communications and Information Systems Assessment

The objective of this phase was to document the existing communications and information systems of each participating agency and understand the communication and information systems requirements of the IMC. This involved defining the requirements for transmitting information required by each agency system (communication and information) to the IMC, as well as between each agency. Representatives of each participating agency were required to review and sign-off on the accuracy of the interview results.

1.3 Schematic System Configuration

From the information collected through the previous two phases, this phase defined the operational requirements of the IMC. This involved the documentation of the roles and responsibilities of the individuals staffing the IMC, and the flow of information exchange required to support effective decision making by the tenants of the IMC. This information exchange refers to the flow of information and data entering and leaving the IMC, as well as moving to users within the facility. The system requirements were arrayed against the information input-output diagrams to define the system functional requirements and preliminary system integration requirements with existing systems.

1.4 Building System Requirements

Building system requirements and space plans were examined to develop an understanding of the anticipated staffing levels, workstation requirements, communication room requirements, and building system/equipment requirements.

This study represents the initial step in the design development process for the IMC. Subsequent investigations and technical design activities will further validate and refine the concepts presented in this report.

The following State agencies and agency divisions participated in this study:

New Hampshire Department of Safety (DOS)
- Division of Fire Safety and Emergency Management
- Division of State Police - Communications
- Marine Patrol
- Information Technology Division

New Hampshire Department of Transportation (DOT)
- Division of Operations
- Bureau of Traffic
- Bureau of Highway Maintenance
- Bureau of Bridge Maintenance
- Bureau of Turnpikes

New Hampshire Department of Revenue and Economic Development (DRED)
- Division of Forest and Lands

New Hampshire Department of Administrative Services (DAS)
- E-911

2. COMMUNICATIONS AND INFORMATION SYSTEM REQUIREMENTS

There will be five (5) primary functional centers housed in the proposed IMC facility:

1. Emergency Management Center (EMC) managed by the Office of Emergency Management
2. Transportation Management Center (TMC) managed by the DOT.
3. State Police Dispatch Center (SPDC) managed by State Police.
4. NHDOT Dispatch Center managed by DOT.
5. E-911 managed by the Bureau of Emergency Communications.

The communication and information systems requirements to support these five functional centers are provided as short term and long-term requirements. Short-term requirements should be operational on opening day of the IMC and are mandatory to the operation of the IMC. Long-term requirements address communications and information system redundancies that are desirable to enhance the performance of the IMC. The feasibility and associated costs of these long-term requirements require additional investigation and discussion with the appropriate agencies.

2.1 Short Term Requirements

Communications and information system requirements to support the EMC must be duplicated and upgraded from the existing location to the proposed location on the campus of the NH Fire Academy. Short-term communications and information system requirements are summarized in Table 1.

Frame Relay Network (FRN) – Currently, access to the Verizon FRN is achieved through two (2) DS-3 and twelve (12) T-1 circuits. Recommended access to the FRN from the IMC is via four (4) DS-3 circuits. This would provide an additional sixteen (16) T-1 circuits above the current connection.

Table 1 – Short Term Requirements (Opening Day)

Radio Frequency Systems	Wireline	Information Technologies and Systems	Building
Common to All Agencies			
	Frame Relay Network – Recommend Four (4) DS-3 Services Lucent Definity G3 Switch for in building telephone system Paging (Zoned) Voice Mail System Cable TV for OEM's EMC and DOT's TMC	100 Mbps Ethernet LAN with possible cross connect with agency specific LANS Video distribution system with direct video connection or IP addressable video (e.g. 1000 Mbps Ethernet) Digital Audio Recorder	Redundant HVAC System for Communications and Operations Centers Redundant Power systems with dual feed for the grid and emergency generator backup Building Security System to include access control and perimeter surveillance Fire Detection & Suppression Time Sync System

Radio Frequency Systems	Wireline	Information Technologies and Systems	Building
State Police			
Two-Way VHF Radio Network Access to support Dispatch Center Microwave Radio Network		SPOTS Frame Video Display (wall system) within Dispatch Center LAN/WAN (100 Mbps Ethernet)	
Department of Transportation			
Two-Way UHF Radio Network to support Dispatch Center within IMC	Frame Relay Network access for video and data transmission from I-93 (Salem to Manchester), I-95, Spalding Turnpike, F.E. Everett Turnpike, US 1 and US 1A bridges and other immediate ITS and Arterial Signal System deployments. This is included in the four (4) DS-3 identified as common to all agencies	TMC will have the following systems: • CCTV Surveillance • Incident Detection • Bridge Monitoring • Variable Message Signs with wireless comm. • Roadway Weather Information Systems (RWIS) • Arterial Highway Signal System • Automated Vehicle Location (AVL) system for maintenance and transit dispatch and monitoring • 511 System • Highway Advisory Radio (HAR) • Commercial Vehicle Information System and Network (CVISN)	
Digital Microwave Network – (i.e. Third Rail Communications)		• Video Display (wall system) within Dispatch Center. • CARS – Condition and Accident Reporting System • MATS – Material Activity Reporting System • FORTELL – weather reporting system • LAN/WAN (100 Mbps Ethernet)	

Radio Frequency Systems	Wireline	Information Technologies and Systems	Building
Office of Emergency Management			
C and K*u* Band Satellite down and up links	Secure Telephones & Fax Machines	SPOTS Frame	
SAT Phone Links (2 minimum)	Phones – Analog, independent of the Definity Switch	E 9-1-1 Frame	
DBS	Fax Machines	Admin. Frame	
Amateur Radio (HAM) System	E 9-1-1 Workstation	LAN/WAN (100 Mbps Ethernet)	
Digital Microwave Network (i.e. Third Rail Communications)	Secure T-1 lines (4 required)	Video Display within EMC	
Civil Air Patrol (CAP) Radio System		Secured Fax and Video Conference Systems	
Mobile Media Paging System			
FNAMS (Federal National Message System)			
FNARS (Federal National Radio System)			
MARS (Military Affiliate Radio System			
HF Radio (2 – 7 MHz)			
C.E.B. Communications Control System			
E-911 Public Safety Answering Point			
To be determined in next phase of wok and will include the replication and upgrade of existing systems present at current facility on Hazen Drive. This center was added as a tenant to the IMC as a result of a presentation with Commissioner Richard Flynn and Commissioner Carol Murray			

2.2 Long Term Requirements

Communications and information systems that should be considered to support the IMC beyond opening day are listed in Table 2. These requirements address issues identified in the assessment of current communications and information systems that would be operational at the proposed IMC.

The requirements are intended to be suggestions that will enhance performance of the IMC and address network access and redundancy issues. Each requirement is briefly discussed below.

Table 2 – Long Term Requirements

Radio Frequency Systems	Wireline	Information Technologies and Systems	Building
Common to All Agencies			
VSAT or other broadband satellite data communications network	Fiber Optic Network for Government (OC-48 or higher) Fiber Optic Backbone (Concord to Manchester)	TBD	
State Police			
Radio network upgrade to trunked operation	TBD	Interoperability between diverse radio networks	
Department of Transportation			
Data radio network to support mobile data terminals and AVL operations	ITS Fiber Optic Network (OC-48 backbone) along limited access rights-of-way (Replaces Frame Relay Network)	TBD	
E-911 Public Safety Answering Point			
	Fiber Optic Backbone (Concord to Manchester) to achieve path diversity to Manchester Central Office.	Interface to TMC and SPDC workstation	

2.2.1 VSAT (Very Small Aperture Terminal) Satellite Communications

The development of a VSAT system for data communications is an alternative for consideration. This communication system provides for fractional or full T-1 bandwidth (1.55 Mbps) from remote locations. It is used where cost associated with building wire line infrastructure is high, and/or where microwave frequencies are unavailable, or the implementation of microwave 1 mls is problematic. VSAT technologies are most cost effective when burst or short duration communication links are required.

Since circuit costs for constant "on" (or 24-hour communication) are expensive, the VSAT application uses multiple ground stations and fewer leased circuits (transponders)

on the satellite. Opportunities to address event or incident driven data communications requirements may be more cost-effective by sharing the costs of these transponders among multiple application users.

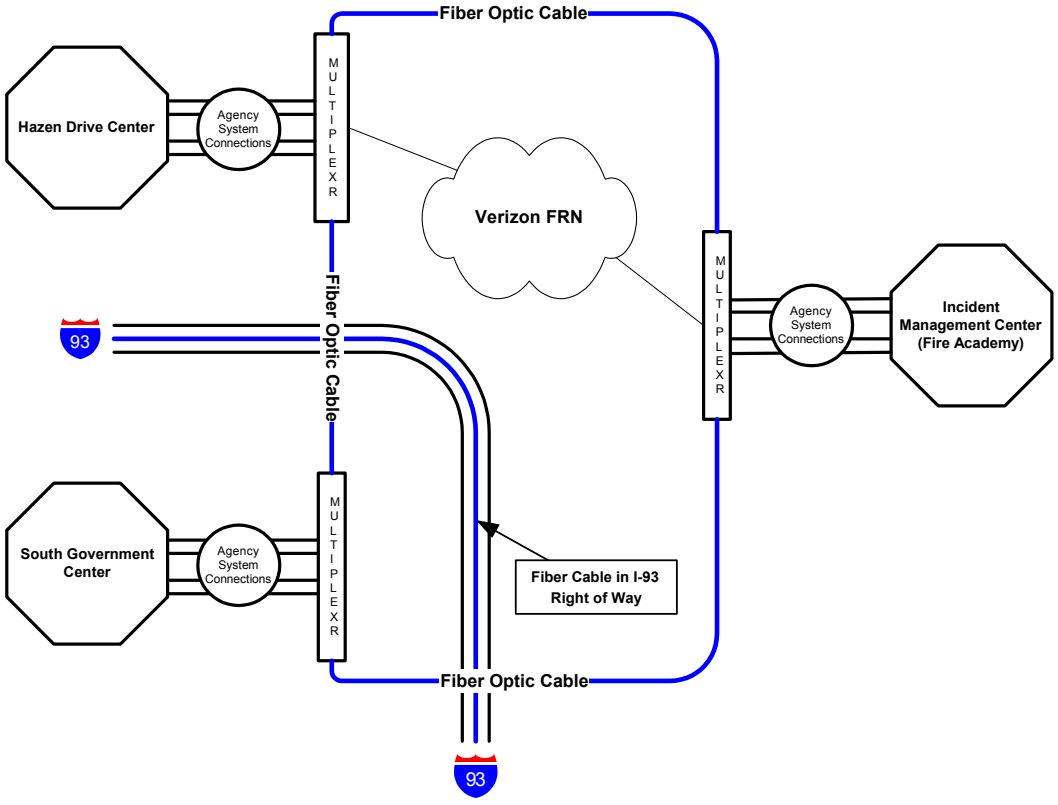
Transmission of digital video and data between the IMC to OEM's Communications Information Services Vehicle (CISV) is one application for VSAT.

2.2.2 Fiber Optic Network for Government

One of the stated functional requirements of the EMC is for each response team member to have access to their home office networks. While this can be achieved with the FRN, it may be more efficient to develop a secure fiber optic network for government use between each of the major government centers: the South Government Center on Pleasant Street, the North Government Center on Hazen Drive and the Fire Academy complex off NH Route 106. This network could also be configured to connect with DRED and other government facilities, as needed.

The fiber optic network also addresses the lack of redundancy of the existing FRN. The current configuration of the network indicates that if the sole service between government center and the Verizon serving central office is disrupted, then the FRN is lost. Using the proposed fiber optic ring, service would not be disrupted as alternate paths from the IMC can be developed. A conceptual drawing of this ring is provided Figure 1.

Figure 1 - Fiber Optic Network for Government



The network would provide sufficient capacity to support real-time video conferencing, real-time video transmission from field locations, full Ethernet connections (100 Mbps or 1,000 Mbps if needed), full bandwidth telephone system links, and support very secure mode communications.

2.2.3 Fiber Optic Backbone Concord to Manchester

The DOT's planned deployment of a freeway management and incident detection system along I-93 will most likely include a fiber optic cable. To increase path diversity, this cable could include sufficient fiber optic strand count between Exits 13 and Exit 15 to carry the proposed government network. The I-93 cable could also be sized to provide a communication path to Manchester. This would allow for a path diverse connection to Verizon's Central Office that serves the FRN used by State Government.

2.2.4 State Police Radio Network Upgrade to Trunked Operation

State Police indicated that the VHF radio system is upgradeable to trunked operation. While this has minimal impact on the communications and information system requirements of the IMC, it may provide significant benefit for incident response by enabling the development of call groups. Frequency availability to enable trunking has not been addressed during this study.

2.2.5 ITS Fiber Optic Network

The full scale development of freeway management systems, bridge monitoring and security systems, closed loop/traffic responsive signal systems and other Intelligent Transportation System (ITS) deployments will create communication system requirements that exceed the capabilities of the frame relay network and/or digital microwave network.

As the ITS program evolves, the DOT will initially bear the cost of additional leased lines and frame relay circuits during the initial development of the program to satisfy the voice and data needs. However, over the long-term, the DOT should plan for the development of a statewide fiber optic network to cost effectively meet the need for voice, data and video transmission. An ITS Fiber Optic Network supporting the statewide program may consist of an OC-48 (2.5 Gbps) backbone network with tributary OC-3 (fiber optic or digital microwave) or OC-12 distribution networks. This network would be developed within the limited access rights-of-way where ITS field equipment is deployed and the likelihood of disruption is minimal.

This network could also become the information path for interstate communications. An example may involve the exchange of information and coordinated response between New Hampshire and Maine for an incident involving the bridges over the Piscataqua River between these states.

Complete resolution of a statewide ITS communications network should be addressed through the development of a communications strategic/master plan. This plan would address the comprehensive needs and requirements of on ITS Fiber Optic Network and develop a network plan to combine fiber optic, wireless and leased services. In addition,

the communications master plan should address the needs of other public agencies and further promoting interoperability for emergency and incident management. An opportunity for a pooled resource program that provides funds from multiple agencies to build a statewide fiber optic network may be possible, particularly when this network would address the need for emergency communications.

3. SCHEMATIC SYSTEM DESIGN

The purpose of a multi-agency facility is to improve public safety through the enhancement of information sharing among responsible agencies. The benefit of public safety / law enforcement agencies partnering with the DOT in a common facility is the improved collection and dissemination of information for initial detection/notification in the field; proper dispatch of police, fire, medical and traffic resources; improved incident response time; and efficient traffic management. Examples include:

- The TMC may possess the capability of rapidly detecting traffic congestion and other incidents on freeways and interstate highways through the use of CCTV, traffic volume and flow sensors, reports from travelers, and by DOT field personnel.

- Programming of overhead Variable Message Signs (VMS) to alert motorists of an incident, defining a detour route, or general traveler information including estimated destination arrival times.

- Special event planning where lane closures and traffic flow patterns are defined by the DOT and enforced by the law enforcement.

- Management of incidents such as natural disasters (floods, ice storms etc.), acts of terrorism, AMBER alerts, life threatening traffic incidents, dignitary protection/escorts, road construction, highway maintenance, and high speed police pursuits.

The success of any project involving multiple public sector agencies depends on inter-agency participation and cooperation. When public safety agencies are involved, it is important to manage information with strict confidence due to the inherent danger of performing law enforcement functions. In an effort to help the dispatchers develop a better understanding of the work environment and purpose of information flow of each agency, an exchange program may be implemented where dispatchers from each agency spend working time with other agency dispatchers. This also creates a positive environment for strong working relationships, respect of other agency requirements, and improved employee morale.

Due to the high level of security of law enforcement functions, the placement of law enforcement dispatchers within the IMC is critical to the success of information flow. The placement must allow for positive exchange of verbal or electronic information with other agencies while ensuring that confidential information is not compromised. Formal policies and guidelines must govern the information and data flow. A strong culture founded on a team approach will guide a successful IMC.

The development of the schematic system design was based on the information requirements defined by each participating agency. The schematic system design serves as the foundation upon which the system functional requirements and the preliminary system integration requirements are built.

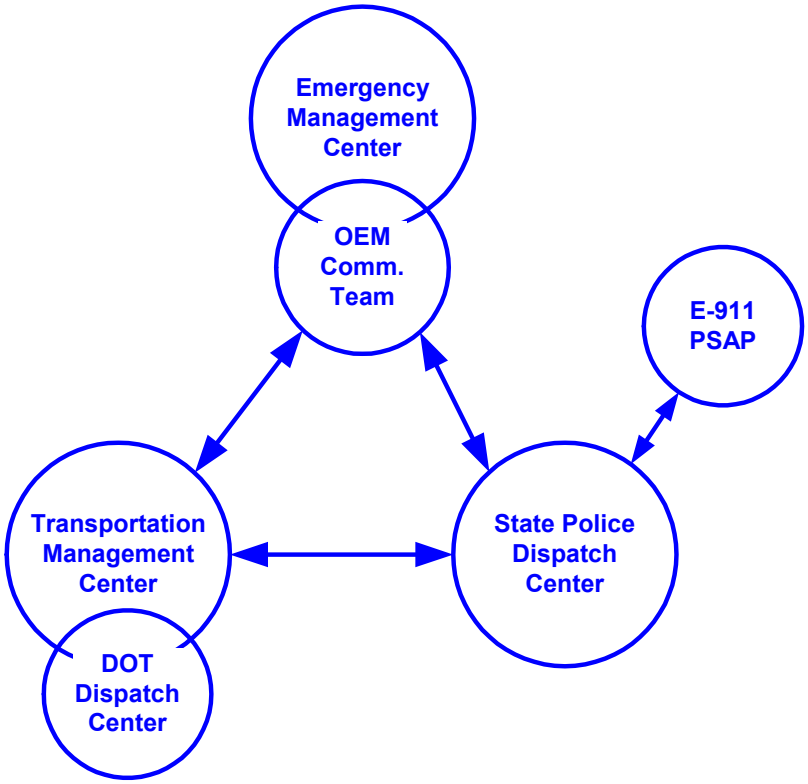
3.1 High Level Information Exchange

The premise of the design is that each operations center within the IMC shares information on a seamless basis as illustrated in Figure 2. Three operational centers will exist within the IMC:

1. The Department of Transportation's Transportation Management Center (TMC) and it's associated dispatch center
2. The Office of Emergency Management's Emergency Management Center (EMC) and it's associated communications team
3. The State Police Dispatch Center (SPDC)

Also resident within the building is the E-911 Public Safety Answering Point (PSAP). This call-taking center is typically the first point where information about an incident is taken, recorded and a response initiated. Collocating the PSAP within the IMC facility will promote the exchange of information between the call takers and the responding operations center(s).

Figure 2 – Primary IMC Operational Centers



At this point in the program development, the IMC is envisioned as having three primary command and control spaces as follows:

- Emergency Management Center
- Operations Center
- E-911 Public Safety Answering Point

The Emergency Management Center (EMC) is a stand-alone space that is generally inactive but when fully activated, houses representative from over 30 agencies. The critical component to the EMC is the Communications Team that provides the communications interface between the 30 agencies, the local EMC's, and other agencies and first responders. Within OEM, the Communications team is defined through the EFS-2 committee

It is recommended that the Communications Team reside within the Operations Center and operate on a semi-activated basis or in a ready state for activation as needed.

The full-time centers within the Operations Center are the Transportation Management Center (TMC) with its associated dispatch center, and the State Police Dispatch Center (SPDC). These two centers are envisioned as operating 24 hours per day seven days a week.

The SPDC will provide full-time communications capabilities from the Operations Centers to each of the barracks based dispatch centers and directly to the vehicles and officers in the field if required. Currently, the SPDC is located on Hazen Drive.

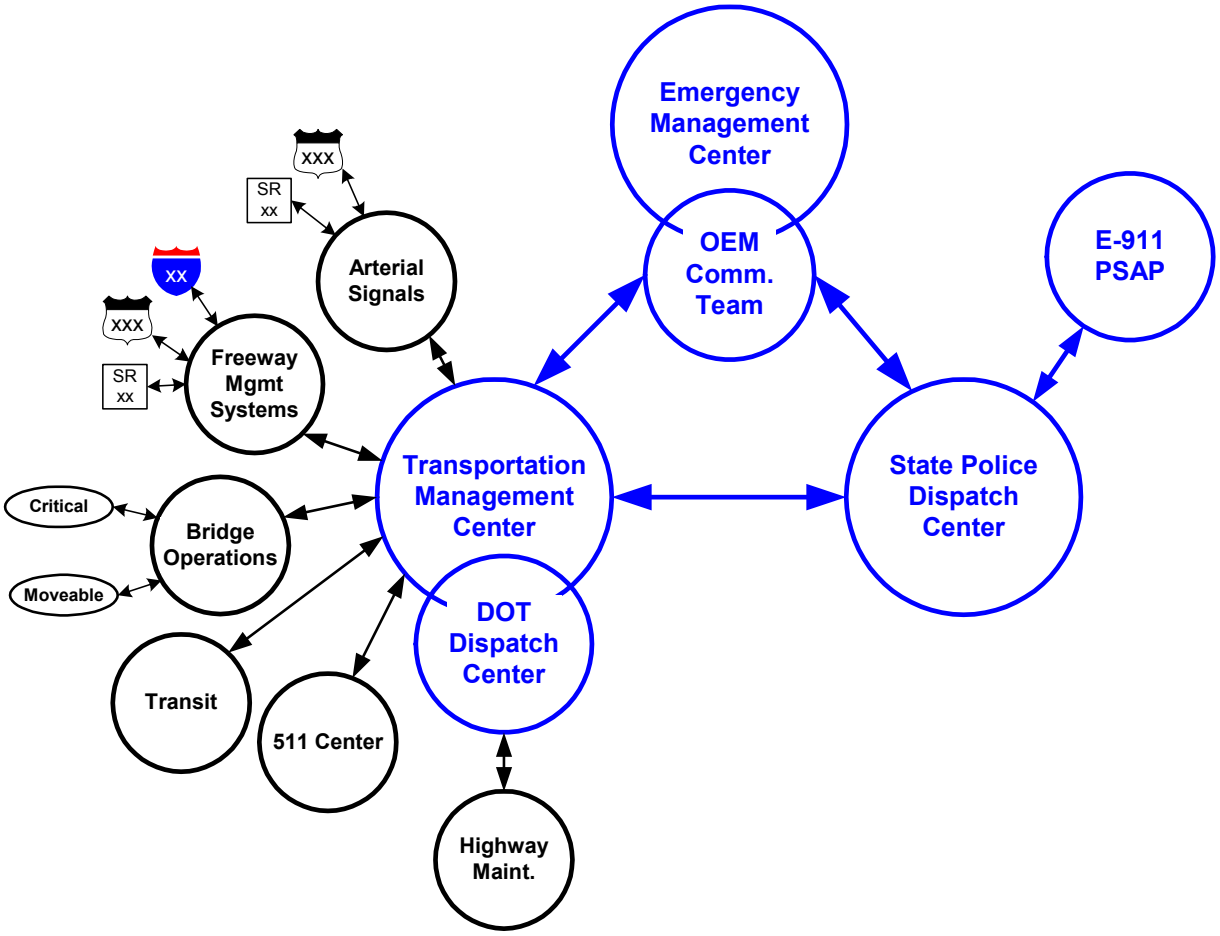
Unique to the TMC is the inclusion of the DOT Dispatch Center. This proposed center provides the opportunity for DOT to migrate to a centralized dispatch operation with supplemental District Dispatch functions, or continue with a decentralized dispatch operation with supervisory/advisory dispatch occurring within the TMC. Centralized dispatch, or functioning as in a supervisory capacity, will allow DOT to effectively and efficiently respond to incidents reported at the IMC on a coordinated basis with State Police and the Office of Emergency Management.

Each of the centers within the IMC receives and transmits information to and from a variety of sources. Today, the communication interfaces for this information exchange are via the frame relay network, telephone, LAN/WAN, two-way radio networks, microwave networks and other media.

3.1.1 Transportation Management Center – The TMC will be receiving information from a number of sources as illustrated in Figure 3. Proposed operational functions within the TMC include:

- Highway Maintenance Dispatch with information flows (voice and data) between the District dispatch centers and the TMC's dispatch center. Roadway weather information systems would be monitored from both the Districts and the TMC. Likewise MATS and CARS would be monitored at both locations.

Figure 3 – Transportation Management Center



- Freeway Management System will receive data and video transmitted from the instrumented limited access highway. Likewise data will be transmitted from the TMC to traveler information system elements in the field to include variable message signs and highway advisory transmitters. Data and video would be generated by systems identified previously in Table 1 – Short Term Requirements.

- Bridge Operations would be supervised within the TMC with actual command and control residing at the moveable bridges. For non-manned critical bridges, the traffic management and security systems would be controlled and monitored from the TMC. Video and data would be generated at the bridges and transmitted via frame relay, leased lines, microwave and eventually fiber optic networks.

- Arterial signal systems on critical routes will provide data and video on operating conditions along key corridors throughout the state. Variable message boards may be located on these critical routes to facilitate emergency detour operations. Information from these routes will be used to effectively deploy and route resources to incidents. Timing plan adjustments to the signal system would be implemented from the TMC to facilitate corridor operations.

- Transit information generated from the transit dispatch center at the University of New Hampshire will be received at the TMC for monitoring operations. Complete functionality of this subsystem requires additional definition.

- 511 Center will be a key traveler information resource for the TMC allowing the public to "dial in" to obtain current transportation operational condition information. The 511 Center will provide automated response as well as operator attended response during critical incidents. Shared databases between the freeway management systems, arterial signal systems, transit, and CARS should be developed in support of the automated response capability of the center.

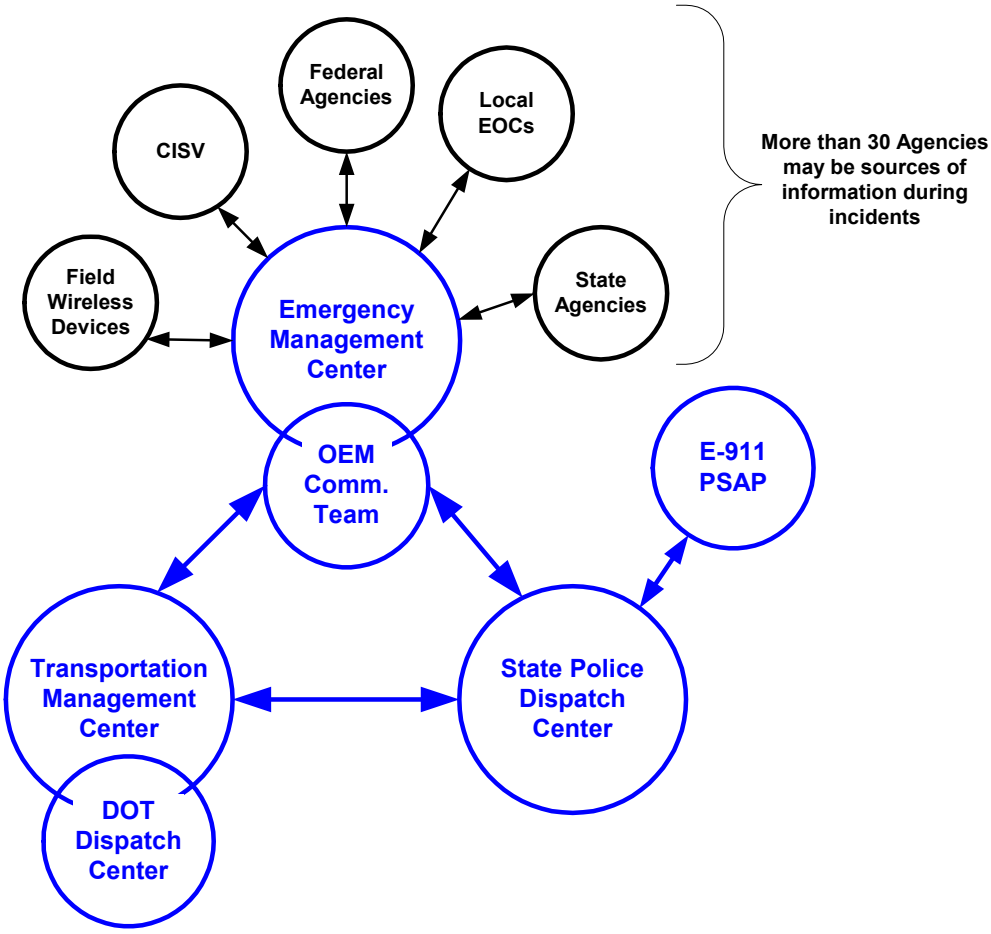
- Local and State Government information exchange, including the potential for exchanging information with the Maine Department of Transportation, the Vermont Agency of Transportation, and the Massachusetts Highway Department will also be facilitated from the TMC.

Workstations developed for the TMC will be the location for operational decision making.

3.1.2 Emergency Management Center – When activated, the EMC will share information with a wide variety of agencies dispersed throughout the state when the EMC is activated., as illustrated in Figure 4. Communications medium to achieve the exchange of information is defined in Table 1 – Short Term Requirements and will be functionally managed through the Communications Team collocated within the Operations Center.

In terms of operations, the EMC will be a recipient of information with which to develop and implement emergency management decisions. Therefore, information from the TMC and SPDC will be ported to the EMC on a continuous basis and will include data and video. Operators within the EMC will be capable of selecting relevant information to display on workstations or the common video display wall visible to all resident agencies in the operations center.

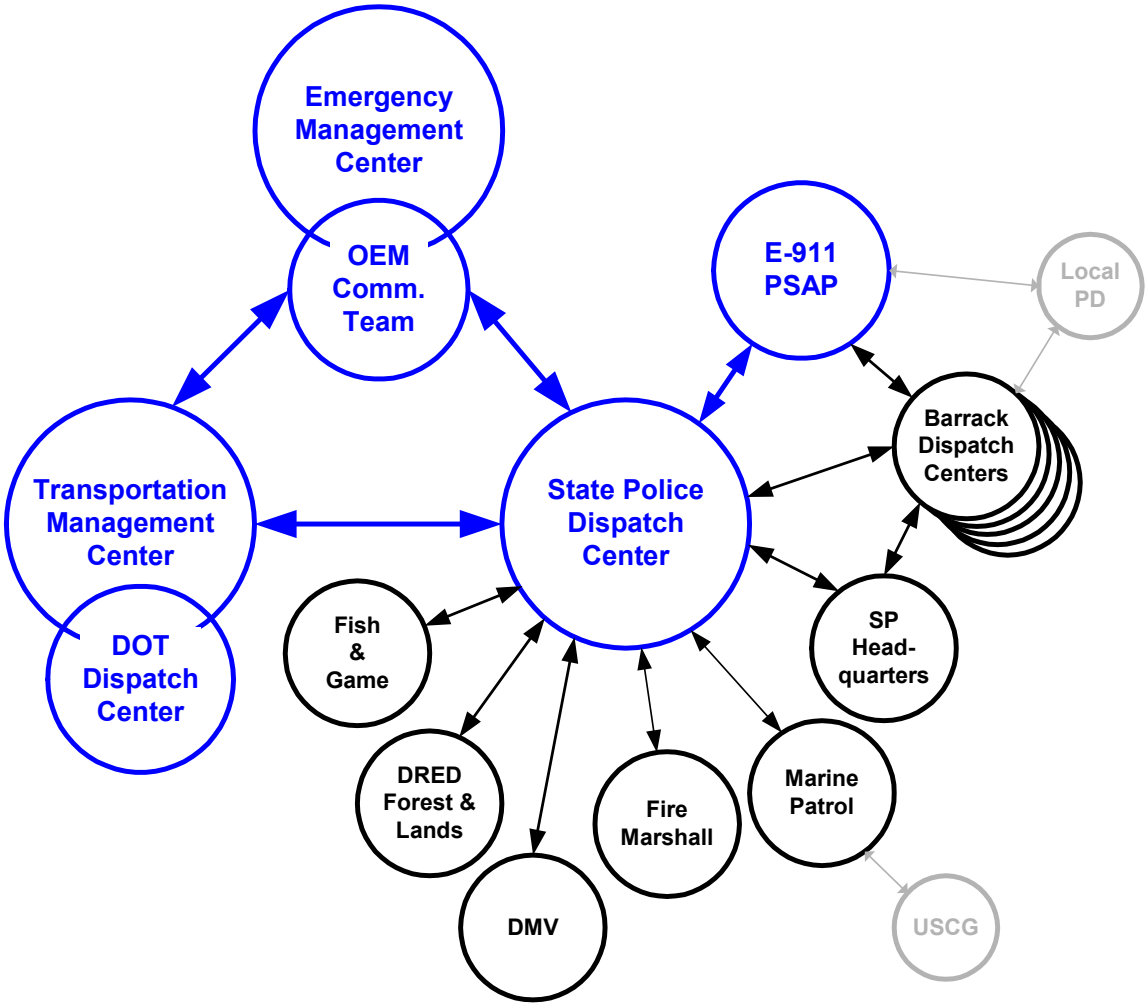
Figure 4 – Emergency Management Center Information Sources



3.1.3 State Police Dispatch Center (SPDC) – The SPDC will have significant needs for information from the TMC on a regular and continuous basis. The SPDC will exchange information with Headquarters and Barracks Dispatch Centers. It will also provide the path for achieving dispatch of other Department of Safety agencies with law enforcement responsibilities as illustrated in Figure 5.

Network interfaces through the FRN will achieve many of the data exchange requirements as they are performed today for SPOTS and other networks. Likewise, radio network access to both the VHF network and the microwave network will be provided at the center to maintain full functionality of the SPDC.

Figure 5 – State Police Information Sources



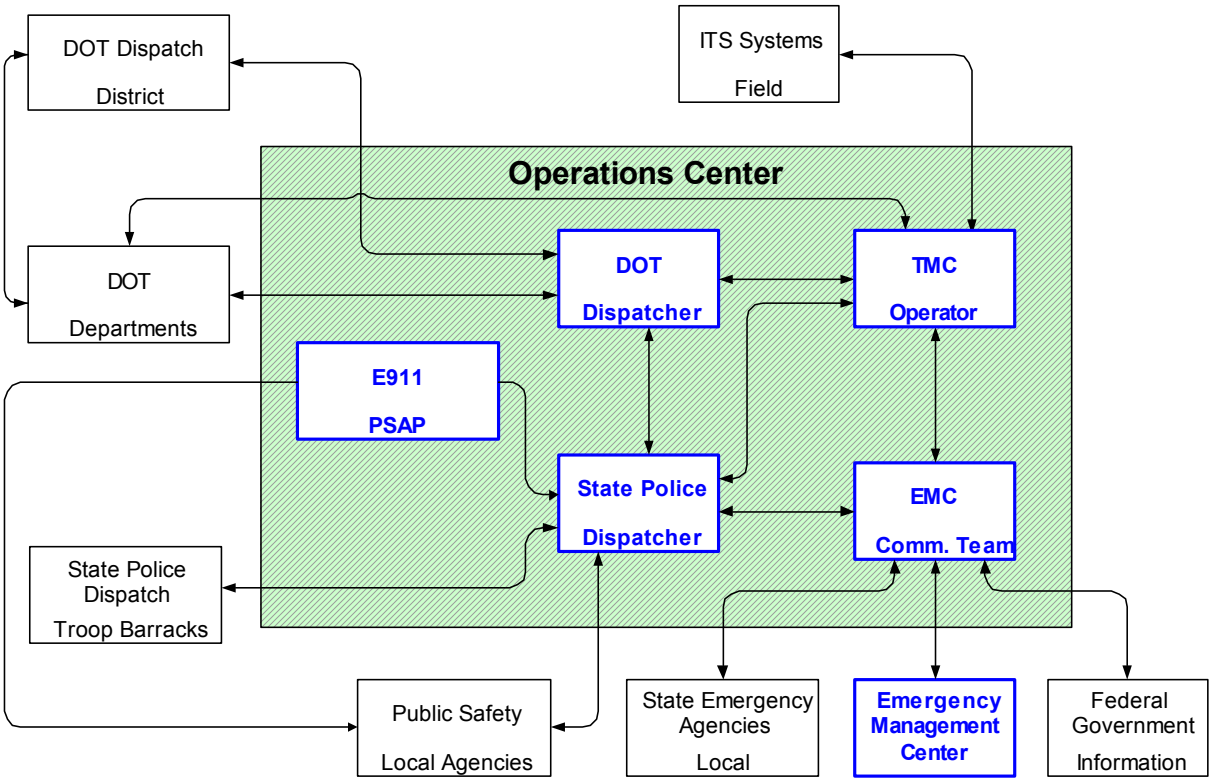
Currently information exchanges between Marine Patrol and the US Coast Guard will remain unchanged. The IMC will have record of the information exchange between Marine Patrol and the US Coast Guard.

The SPDC will have direct data links with the E-911 PSAP within the IMC to obtain information required to effectively respond to incidents within their jurisdiction. Communications interfaces to support this alternative should be developed for the facility.

3.2 IMC Information Flows

Within the IMC, information flows occur along multiple paths as illustrated in Figure 6. While this diagram is a simplification of all flows, it focuses on the exchange of information to manage response to incidents on a coordinated basis from multiple agencies.

Figure 6 – IMC Information Flows



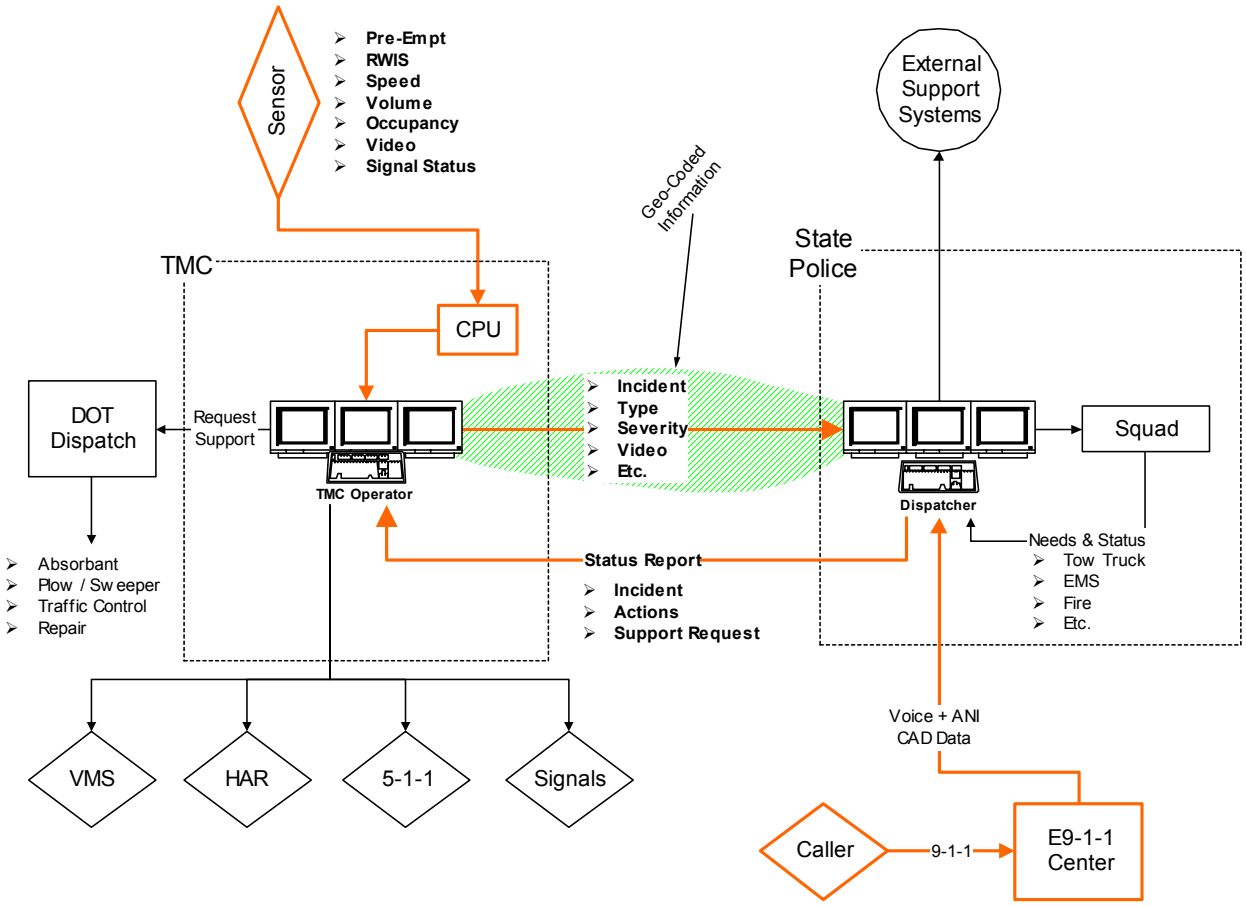
Information exchanges occur between each type of operator/dispatcher workstation within the IMC. In the event of an incident, the busiest workstations will be those of the State Police Dispatcher who receives and directs information from six sources and the TMC operator who receives and directs information from five sources.

3.3 Incident Information Exchange

To further illustrate information flows and the importance of a coordinated response, a scenario is illustrated in Figure 7. In this scenario, DOT's freeway management system detects and verifies an incident within two (2) minutes of its occurrence. This level of performance accounts for the time it takes for the highway based traffic management system to detect the incident and for the

TMC operators to view the incident using the CCTV surveillance system, validate the event, and develop an initial assessment of its severity.

Figure 7 – Incident Information Flow



In this scenario, incidents are simultaneously detected by DOT through the senor array on a fully instrumented section of highway and by the E-911 PSAP from a passing motorist using a cell phone.

Within minutes of the event, video camera are focused on the scene and images are displayed on the TMC's video wall along with incident data automatically recorded by the traffic management system providing geocoded information. The TMC operator completes an incident report form completing information regarding number of vehicles involved, potential severity and other key information needed by State Police. When the incident report is entered into the system, an automated incident log report is opened to track the incident and the corresponding response. Upon entry of the report, the information is automatically transmitted to the SPDC within the Operations Center and the State Police Dispatch is provided access to the CCTV camera closest to the incident.

Concurrently, the accident report received at the E-911 PSAP is forwarded to the appropriate State Police Barracks Dispatch Center and to the SPDC. Therefore, the State Police Dispatcher has received information from two sources that can be reconciled to determine if there is a single or multiple incidents. State Police access to the video will be important to reconciling the incident and determining the appropriate response to the incident.

Upon formulating a response, the Dispatcher notifies State Police forces and the TMC operator to confirm the incident and request any additional information and support services needed from DOT.

The TMC operator would then pass this information on to the DOT Dispatcher who would place the request for support with the appropriate Maintenance District for traffic control, spill absorbent materials and other resources available to the DOT, as needed.

Similarly, the same information can be transported to Emergency Management Center when it is activated to provide real-time condition information on evacuation routes as well as routes being used to deliver resources to the scene of an incident.

3.4 Conceptual Layouts

Based on the information exchange requirements discussed above and the results of a workshop, a conceptual layout of the proposed Operations Center and Emergency Management Center were developed. A conceptual layout of the E-911 PSAP was not developed since this is a separate space within the IMC with electronic information exchange.

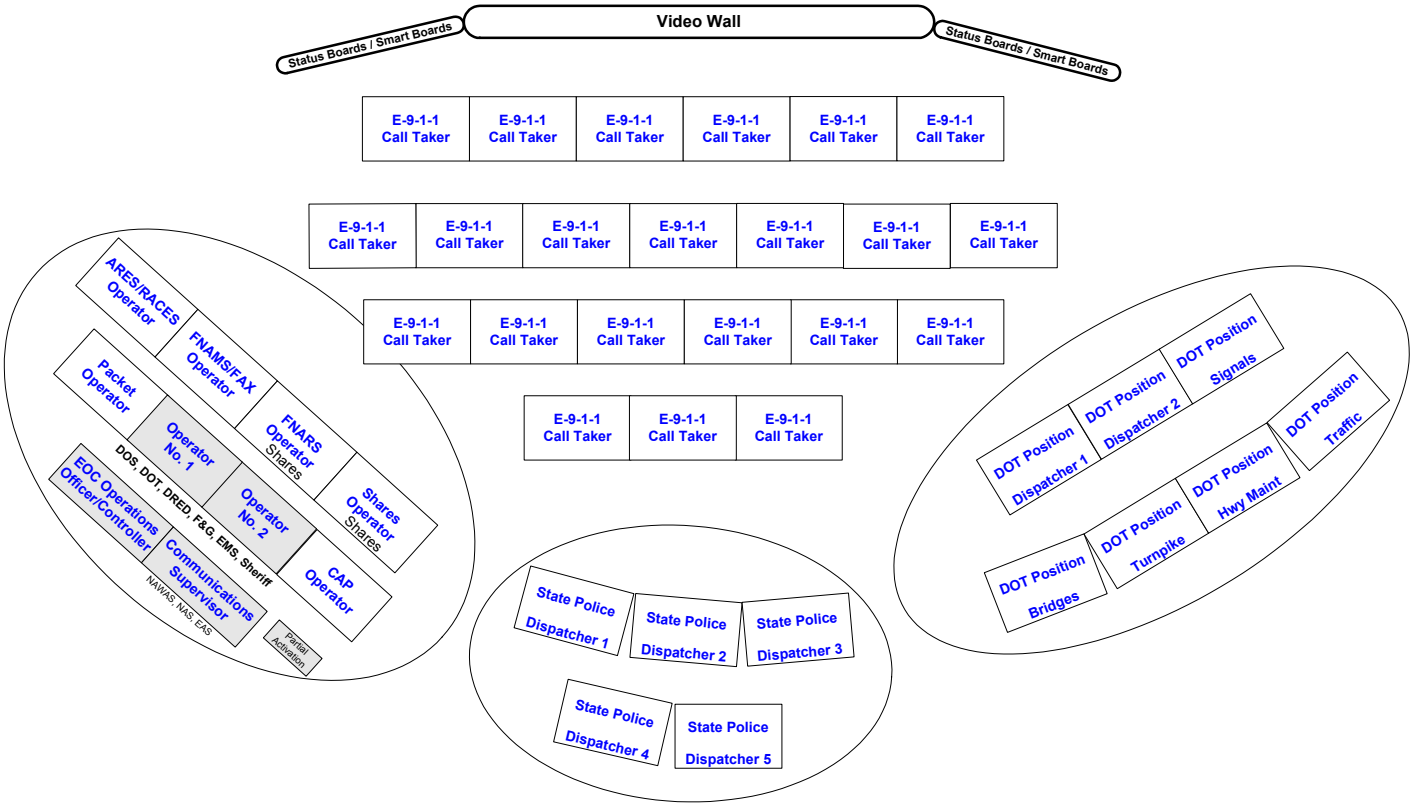
These conceptual layouts identify the importance of the adjacency of the spaces within which the TMC, EMC and SPDC centers reside.

3.4.1 Operations Center – The criteria developed for the arrangement of space is as follows:

- SPDC requires five (5) dispatch workstations
- TMC/DOT Dispatch requires seven (7) dispatch workstations
- EMC Communications Team requires ten (10) workstations for full activations of the EMC. Only four (4) of the workstations would be used during a partial activation of the EMC.

Based on these requirements a conceptual layout of Operations Center was developed, as illustrated in Figure 8.

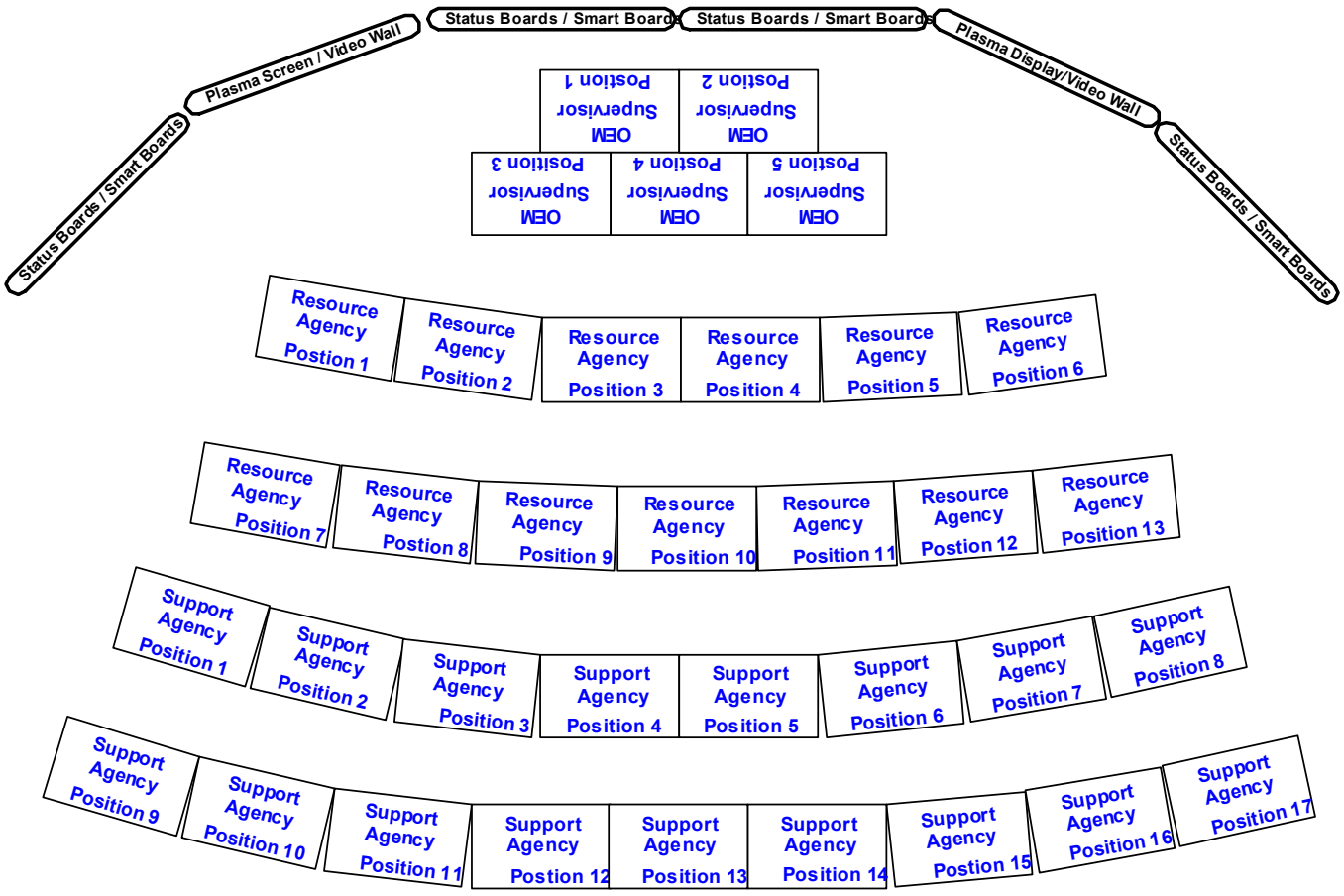
Figure 8 – Operations Center Conceptual Layout



In addition to the Operations Center itself, this facility should be supported by additional space to include conference rooms, radio broadcast rooms and other ancillary support facilities to be determined in the final design process.

3.4.2 Conceptual Emergency Management Center Layout – There are many different approaches for the special arrangement of the EMC. Based on the requirements, the conceptual layout provides space for 30 people and supervisory personnel, as shown in Figure 10. The need for 30 workstation, or work desks, are required since individual EMC "operators" are from potentially 30 different agencies. The final EMC layout will be developed as part of the design process.

Figure 9 – Conceptual Emergency Management Center Layout



4. BUILDING SYSTEMS REQUIREMENTS

In determining the building system requirements for the IMC, the current EMC and SPDC systems and the agency requirements for additional systems within the new IMC were considered. This document is intended as a guide for equipment types and general functionality described in the preceding sections of this report. It does not represent a fully designed system and should be used only as a framework for additional engineering. In this same spirit, data in the Appendix B-1 through B-5 is presented as an example of the type of equipment required and is not an endorsement of the actual product.

4.1 Power System

The Power System includes Utility power distribution, Engine-Generators, Uninterrupted Power Supply (UPS), and associated equipment required to insure that the IMC has reliable power.

It is recommended that the Power System include a Power Monitoring and Control System (PMCS). This will allow building personnel to have a complete understanding of the Power System's current status and allow them to make proper control decisions. A workstation for the PMCS should be installed in the security room (or another workstation staffed continuously). The PMCS should also be capable of sending messages (via telephone, pager, e-mail or other similar methods) to personnel not at the PMCS workstation.

4.1.1 Utility - Utility power shall be obtained from a feed as close to the Utility substation as possible. Even if only one substation can source the IMC, two Utility feeds will be used, so that if one of the feeds is damaged or otherwise off line, the IMC can still be supplied from the other feed. Electrical switchgear in the IMC shall allow power to be delivered from either feed to any user in the building. The electrical switchgear shall be co-located with the Engine-Generator.

4.1.2 Engine-Generators - Two Engine-Generator sets are required, with the second set redundant to the first. An Engine-Generator shall start, achieve rated voltage and frequency, and be capable of accepting load within 10 seconds. The engine type should be one of the following:

- Reciprocating internal combustion
- Gas turbine
- Steam Turbine

The recommended engine is a bi-fuel Diesel/LPG system, subject to federal criteria currently under development so that the existing site LPG tanks can be used as a secondary fuel source. Most diesel engines be considered to replace both the generators and UPS system. Today, the installed cost per kilowatt-hour makes this type of system not cost effective, but the costs may change before actual construction is undertaken. A Combined Heat and Power (CHP) system should also be considered

The Engine-Generators shall be capable of operating in all temperature conditions expected in the generator room. A hospital-zone exhaust silencer rated for 30dBA

minimum sound level reduction from open pipe is required with each Engine-Generator to reduce noise external to the building while the set is in operation.

The Engine-Generators shall be installed in a generator room inside the IMC or in a fully enclosed shelter attached to the IMC. Access to the generator room from the IMC shall not require going outdoors. Combustion air and exhaust will be provided by plenums ducted to the roof of the generator room. The generator room shall be sound insulated so that the adjacent space in the IMC does not exceed 65dBA. It shall be sized to contain the generator, fuel tank, fuel pumps, generator and utility switchgear, generator controls, and service space. The generator room shall have a door to the outside sized to allow service of all equipment in the room, including removal/replacement of any component. Access to the generator room (from both within the IMC and from the outside) shall be strictly controlled and monitored by the security system.

The fuel tank shall be installed in the generator room. It shall be sized to supply 14 days of fuel to the generator system at full capacity. This capacity shall be met without resorting to the secondary LPG fuel source (if present). The fuel tank shall be installed above ground so that it can be inspected for damage.

The power generation system shall have the capacity to fully supply the following loads (with a buffer of 25% system expansion):

- All UPS backed systems (see below)
- HVAC components supplying cooling air to computer, networking and communications systems
- Elevators
- Emergency lighting

It is expected that the generator system capacity will be in the 250kW class and will require an area of at least 20'x30'. See *Appendix B – Power System Equipment* for examples of generation equipment capabilities and pricing.

4.1.3 UPS - The UPS shall operate in conjunction with the rest of the IMC electrical system to provide power conditioning, back up and distribution for critical electrical loads. The UPS shall be divided into multiple modules for maintenance and expansion ease. N+1 module redundancy is required. The UPS shall be an on-line system to insure that there is no power interruption to the load upon Utility power failure or poor Utility power quality. UPS batteries shall be sealed, maintenance-free units. The UPS shall include a battery monitoring system, which periodically tests each battery to insure that it is working properly. The UPS shall be installed to a dedicated UPS room sized for the system and rated for battery storage. Access to the UPS room shall be strictly controlled and monitored by the security system.

The UPS shall be sized to fully supply the following loads for 10 minutes (with a buffer of 25% system expansion):

- Servers
- Workstations
- Radios
- Networking equipment
- Security System
- Other Communications Equipment

It is expected that the UPS capacity will be in the 100kW class. Since computer technologies change rapidly and typically require more power for each generation, space should be set aside for 50% additional modules to be added as the system matures. Total space for the UPS room should be 8'x10' to allow for initial equipment, expansion, and service. See *Appendix C – Uninterrupted Power Supply Equipment* for examples of UPS equipment.

The telephone system shall be supplied from a separate UPS/battery backup system. This backup shall supply the telephone system for eight (8) hours without Utility or Generator power. This backup will require ½ of a 24" equipment rack in the telephone room. This rack space should be shared with the telephone switch.

4.2 Security

Security of the IMC is essential for both normal operations and operations during an incident or emergency situation. In addition to the procedural security measures that should be taken, the building shall include Video Surveillance and Access systems. A Security officer shall monitor and control the Security system on a twenty-four (24) hours basis from the Security room. Total space for the Security room should be 8'x10' to allow for initial equipment, expansion, and service. See *Appendix D – Security System Equipment* for examples of various types of security equipment.

4.2.1 Special Areas - In addition to the requirements outlined below, some areas require special handling to meet all security requirements. Both the EMC's multi-purpose secure room and the secure communications room require full-height walls and reinforced doors. In addition, the secure communications room should have an RF shielding grid around the entire room (walls, floor and ceiling). These rooms may also require document safes.

4.2.2 Video Surveillance - A full-coverage CCTV camera system is required for the IMC building's exterior. This shall include pan-tilt-zoom cameras located on the building rooftop and positioned so that all access points are under view of at least one camera. In addition, a high-mounted camera shall be used to monitor the parking lot for possible threats. Cameras are also recommended at each entrance to the IMC and inside the building at the doors to:

- Operations Center (SPDC, TMC, and EMC)
- EMC's multi-purpose secure room
- Secure communications room

- Network/Server room

All CCTV video shall be brought back to the Security room. The security room shall include CCTV monitors, camera controls, digital recording equipment, and video switches so that security personnel can fully utilize the Video Surveillance system. The system shall also include the capability of sending the video to the operating centers within the building.

4.2.3 Access - The Access system shall be designed so that movement within the building is limited to authorized persons. Possible access control methods to consider for use alone, or in combination, include:

- Human visual verification
- Keyed locks
- Keypads
- Insertion badges
- Proximity badges (both passive and active)
- Fingerprints, hand geometry, facial recognition and other biometric systems

At the current time, for automatic access, passive proximity badges with keypad are recommended as a cost effective and secure system. All data networks required for the security system shall be encrypted and monitored so that tampering with or attempting to disable the system results in notification of Security. The system chosen for installation shall allow cards and keypad PIN's to be activated and deactivated for individual doors at any time by security personnel.

All doors and windows shall be monitored for unauthorized opening and alarmed in the Security room. A computer workstation there will allow monitoring and control of the Access system.

4.3 Fire Detection and Suppression

A Fire Detection and Suppression (FDS) system is also essential to the operation of the IMC. In addition to the fire and smoke detectors, pull stations, extinguishers, and water sprinklers required to meet standard safety and regulatory requirements, the IMC has specific needs.

The FDS shall include a computer workstation in the Security room that monitors all FDS components and can take appropriate action when a fire is detected. This includes integration with HVAC system for containment and smoke purge.

In areas where there are critical electronic systems, the Fire Suppression shall be suitable for use on electronic gear without damage to it. These areas include:

- TMC
- SPDC
- EMC's multi-use secure room

- Secure communications room
- Network/Server room
- Generator room
- UPS room

Possible systems for these areas include:

- HALON 1301
- FM-200
- CO_2
- Inert Gas (INERGEN or Argonite)

Assuming the above spaces are a total of 24,000 ft^3 and are closely located so that a single system can be used, an FM-200 system would require two tanks for protection. Tank storage would require a 6'x4' space allocation. FM-200 is recommended for this application. HALON 1301 would require slightly less space, but it not suitable for new installations. CO_2 would require twice as much space (6'x8') with Inert Gas requiring twice as much space as CO_2 (12'x8'). See *Appendix E – Fire Detection and Suppression Equipment* for examples of various types of FDS equipment.

4.4 Heating, Ventilation and Air Conditioning (HVAC)

The HVAC system should be designed and installed to standard building specifications. Although protection systems for chemical, biological and radioactive contamination were discussed, no participating agency listed this as a requirement for the IMC. This issue may be revisited at design time as new federal guidelines are released.

The HVAC control system should include a computer workstation providing monitoring and control of the entire system. It should also interface with the FDS system for containment and smoke purge (see above).

The only non-typical requirement is for the Network/Computer room. Electronic and information processing equipment require rigid environmental conditions for reliable operation. Precision air conditioning systems specifically designed for the concentrated vertical heat loads shall be used. This type of air conditioner provides efficient heat removal, excellent humidity control, greater airflow, better air filtration, greater flexibility and expandability, and numerous alarm and redundancy options. The room will have a raised floor to facilitate this type of installation.

Depending on the final building arrangement, the Operations Center may also contain significant computer cooling loads and thus require the same type of system as the Network/Computer room.

An adjunct to consider is adding an indoor air quality monitoring system. This system would allow the building to be monitored for poor air quality and for the HVAC system to make automatic adjustments to help correct the problem. See *Appendix F – Heating, Ventilation, and Air-Conditioning Equipment* for additional information on Precision HVAC equipment.

4.5 Computer Systems

The computer systems within the IMC are critical to all areas of operation. Given this, all equipment should be chosen to provide the highest level of up time, with minimum maintenance. Since power usage determines both electrical and cooling requirements, all computers shall have LCD displays to reduce the UPS and HVAC load they cause.

Server computers shall be rack-mounted chassis designed for high reliability and performance. Stand-alone workstation computers shall be chosen similarly for high reliability and performance, but shall be avoided if possible. Thin client workstations shall be used whenever possible. This type of architecture provides the following benefits:

- Low UPS loading (15W without the monitor)
- Does not require special HVAC
- Convection cooled - quiet
- Small footprint (can be bolted to the bottom surface of a table or desk)
- All data is stored in a server computer
- Software maintenance preformed outside of the Center so that IT functions do not interfere with operations
- Lower cost

4.5.1 EMC - In examining the existing computer system for the EMC, it was determined that there are 15 COTS (Commercial Off The Shelf) software applications and an additional 15 custom applications being used in the facility. Thirty participants from various agencies use these applications when the center is activated. Currently, participants bring their own computers and use them in the center, but this does not work well. Most interviews desire connectivity to their agency's local area network to access their databases and records. The recommended computer equipment for the EMC is as follows:

- One File Server/Domain Controller
- One Alternate File Server/Domain Controller
- One Print server
- Two enterprise level printers
- Four local color printers
- Six Application Servers
- Two Terminal Servers
- Two stand-alone laptops for secure HF
- Two stand-alone workstations for messaging
- Four thin clients for plume tracking and prediction
- Thirty thin clients for participants
- Two projection-based intelligent white boards
- A flat panel computerized video wall capable of displaying CCTV and computer video from any source entering the building
- Other thin clients and laptop computers as needed for office and support staff

Given the above equipment list, two full-height 19" server racks should be allocated in the Computer/Networking room for the EMC servers and associated networking equipment. An equal number of racks are required for passive components (patch panels, punch blocks and wiring management).

In addition to this equipment, video display systems using plasma screens should be considered for the display of information (video and data) generated from the TMC. Additional display technologies that should be considered for the EMC include dynamic white board (a.k.a Smart Boards) that allow the projection of computer images (such as forms) onto a specialized white board which is used to record annotated information in the image. This type of system would allow for automatic digital recording and replace the manual status boards currently used in the existing EMC. In the event of a computer system failure, the white boards continue to function as a manual backup.

4.6 State Police Dispatch – Five (5) State Police dispatch consoles shall be configured the same as existing consoles at State Police headquarters. The dispatch area shall visual sightline to the Operations Center computerized video wall which will be capable of displaying CCTV and computer video from any source entering the building. The State Police also need a Server for digital voice recording of telephone and radio conversations.

4.7 DOT Dispatch - DOT does not currently use computers for dispatching, however it is anticipated that they will in the TMC. Two (2) consoles with radio controls and a thin client computer with access to the DOT CAD server and other DOT computer systems is required. These consoles will be located in the TMC (see below). In addition to radio communications, applications to reside on the Dispatch Workstations include Automatic Vehicle Locations Systems with Computer Aided Dispatch and mobile data terminal messaging systems

4.8 DOT TMC - Since there is no current TMC to examine, the requirements for its computer system will need to be refined as the design proceeds forward. Positions will include the two DOT Dispatch consoles. Four (4) primary consoles are required with multiple displays along with two secondary consoles. These consoles area assigned to TMC operators and will host the Intelligent Traffic Systems (ITS) applications residing in the TMC. The ITS applications anticipated were previously identified in Section 2.1, Table 1 – Short Term Requirements (Opening Day) and include:

- Freeway Management Systems encompassing:
  - Variable/Dynamic Message Sign Systems
  - Traffic Monitoring and Detection Systems
  - Roadway Weather Information Systems
  - Highway Advisory Sign Systems
  - CCTV Surveillance Systems

- Bridge Operations Systems encompassing:
  - Traffic Monitoring System
  - Gate Control and Monitoring System
  - Moveable Bridge Monitoring System

  - CCTV Surveillance system (Bridge Deck)
  - Video Security System (Perimeter, waterway/channel and under deck surveillance)
  - Motion/Presence detection security system

- Arterial Signal Systems
  - Signal pre-emption systems (for emergency response vehicles)
  - Variable/Dynamic Message Sign Systems
  - Traffic Monitoring and Detection Systems

- Database Systems encompassing:
  - CVISN
  - CARS
  - MATS
  - Fortell
  - Incident Logging and Reporting

- Traveler Information Systems encompassing:
  - 511
  - Web-Based Information Systems

- E-Mail/Web access

- Other related applications

Computer equipment to support all anticipated ITS applications should be very similar to the EMC requirements:

- One File Server/Domain Controller
- One Alternate File Server/Domain Controller
- One Print server
- Two enterprise level printers
- Four local color printers
- Six Application Servers
- Two Terminal Servers
- A DLP computerized video wall capable of displaying CCTV and computer video from all DOT sources. Stand alone monitors will be located to the left, right and above the video wall display.
- Twelve (12) thin clients for the primary consoles (three per console)
- Five (5) thin clients for the secondary consoles and dispatch stations
- Other thin clients and laptop computers as needed for office and support staff

Given the above equipment list, two full-height 19" server racks should be allocated in the Computer/Networking room for the TMC servers and associated networking equipment. Since the TMC will also include networking equipment for field connections to ITS components, additional racks are required. Experience with other similar systems has shown that a video rack

and at least three other equipment racks will be needed. An equal number of racks are required for passive components (patch panels, punch blocks and wiring management). This brings the total rack space required to a minimum of twelve (12) racks.

In addition to this equipment, the TMC will have a complete video wall system for the dynamic display of video images from field CCTV cameras, as well as computer generated information such as condition maps and other graphical displays. The video wall is envisioned to consist of a three (3) cube high by five (5) cube wide wall. Each cube will have a 67" diagonal (or larger 84"). Overall width is 22.5 ft. and could go to 28 ft. with the larger screen. Overall height is 10+ ft. to 13 ft. Overall depth is 48" plus a corridor behind for access to the equipment and to facilitate replacement when needed.

This wall could be supplemented by HDTV monitors for display of video either from CCTV camera or commercial sources such as Cable Television for access to all news channels, weather channels and public access/government channels.

5. CONCEPTUAL COST ESTIMATE FOR TECHNOLOGY

Based in the information developed in this study, a conceptual cost estimate for the technology components of the IMC has been developed. The technology components are:

- Communication Technology (communications links)
- Building Systems (required to support the Communication Technology and the Information Systems)
- Information Systems (computers & servers, telephone systems, video wall and dynamic white boards)

It must be noted that this conceptual cost estimate requires additional refinement prior to programming for the design and construction of the building.

At the time of the investigation, the E-911 PSAP was not included in the IMC program. Subsequent discussion with the Department of Safety has resulted in the addition of the E-911 PSAP to the program. Investigations into the latest technologies supporting the PSAP are needed to update the facility even though a new redundant PSAP has been commissioned in the past month.

The total conceptual cost estimate for technology systems required for the IMC is estimated to be $5.4 Million. Table 3 provides a breakdown of the technology components into communications technology, building systems, and information technology.

The addition of the E-911 PSAP could increase this cost by $2.2 Million or more depending on the degree of systems upgrade requirements and the impact on the building systems.

Table 3 – Conceptual Cost Estimate for Technology

Item	Qty	Space	Unit Price	Extended Price
COMMUNICATIONS TECHNOLOGY				
Communication Links				**$ 800,000.00**
DS-3 Multiplexers	8		$ 25,000.00	$ 200,000.00
Microwave Links	2		$ 100,000.00	$ 200,000.00
Fiber Optic Network				**TBD**
Tower	1		$ 400,000.00	$ 400,000.00
BUILDING SYSTEMS				
Power System				**$ 714,000.00**
500K Generator	2		$ 141,000.00	$ 282,000.00
UPS	1		$ 200,000.00	$ 200,000.00
Fuel Storage	1		$ 50,000.00	$ 50,000.00
Utility Feed	2			**TBD**
Electrical Switch Gear	2		$ 91,000.00	$ 182,000.00
Security System				**$ 250,000.00**
CCTV	1			$ 100,000.00
Access Control	1			$ 150,000.00
Fire Detection & Suppression				**$ 250,000.00**
Network/Comm Room (Supplemental)	1		$ 250,000.00	$ 250,000.00
HVAC				**$ 100,000.00**
Computer Cooling (Supplemental)	2		$ 50,000.00	$ 100,000.00
SUBTOTAL				**$ 1,314,000.00**
Item	**Qty**	**Space**	**Unit Price**	**Extended Price**
INFORMATION TECHNOLOGY				
Computers & Servers				**$ 2,419,000.00**
Dispatcher Workstations	22		$ 100,000.00	$ 2,200,000.00
OEM Workstations	30		$ 1,400.00	$ 42,000.00
Radio Control System	Included in Dispatch Workstation Cost			
Servers	20		$ 7,000.00	$ 140,000.00
Printers	10		$ 2,500.00	$ 25,000.00
Plotters	2		$ 6,000.00	$ 12,000.00
Telephone System				**$ 268,750.00**
Telephone Desksets	75		$ 250.00	$ 18,750.00
PABX	1		$ 250,000.00	$ 250,000.00
Video Wall and Dynamic White Boards				**$ 600,000.00**
Operations Center	1		$ 350,000.00	**$ 350,000.00**
State Police Dispatch Center	Included above			
Emergency Management Center	1		$ 250,000.00	**$ 250,000.00**
INFORMATION TECHNOLOGY SUBTOTAL				**$ 3,287,750.00**
Grand Total				**$ 5,401,750.00**

30-Jul-03